

AUTOMATED WATER SAMPLE COLLECTING SYSTEM

CROSS REFERENCE TO RELATED PATENT APPLICATION

This invention is related to U.S. patent application Ser. No. 08/122,384 filed Sep. 16, 1993 for "MULTI-PORT VALVE FOR FLUID TRANSFER SYSTEMS". The coinventors and assignee of the related patent applications are the same.

TECHNICAL FIELD

This invention relates to a new time series water sample collecting system for collecting water samples of specified volume at programmed intervals in a submarine or subaqueous environment. The invention is particularly applicable for use at remote locations. The water sample collecting instrument is operated by a programmable controller for fully automated operation. Between the water sample collecting events, a reversible pump and multiport valve are controlled to dispense cleaning liquid such as an acid through the water sample intake line to wash away biofouling material and minimize contamination of samples. The acid wash is then flushed away by distilled water. The system is applicable for collecting water samples in oceans, lakes, or rivers for a wide variety of analyses and studies, e.g. nutrient levels, CO₂ concentration, dissolved organic matter, trace elements, pollutants, etc.

BACKGROUND ART

A variety of multiport valve mechanisms have been developed for backwashing filters. For example, the Reece et al. U.S. Pat. No. 3,703,465 issued in 1972 for a "Filter With Rotating Backwash Selector" describes a filter assembly with multiple filter elements arranged in a circular ring configuration. All of the filter elements of the Reece et al. device are used at once for simultaneously filtering a liquid flow.

According to Reece et al. the backwash mechanism incorporates a rotatable inlet channel and a rotatable outlet channel which can be stepped in synchronism from filter element to filter element and coupled respectively to the ends of each elongate filter holder. A separate backwash fluid can then be flushed through the selected filter element in a backward direction while the other filter units continue to be used for regular filtration in a forward direction. The backwash valve of Reece et al. is then stepped by a motor and drive from filter unit to filter unit for sequentially cleaning the filter assembly.

A disadvantage of the Reece et al. backwash selector is that it is not applicable for use with sample collecting systems using sample collecting tubes, bottles, syringes or bags intended for one way receipt of liquid. Nor is the Reece et al. device designed for submerged, subaqueous, or submarine use.

The Litzenburger U.S. Pat. No. 4,430,220 describes a similar device for selective channeling of backwash fluid for flushing out filter elements. In the Litzenburger apparatus the filter elements are also arranged in a radial sequence. A hollow rotary valve is connected to the respective ends of the filter elements in rotary sequence for backflushing. The Muller U.S. Pat. No. 3,380,591 describes another fluid filter assembly with an automatic cleaning device for backflushing and cleaning filter elements. Again neither of these devices is

designed for filling sample collecting devices which ordinarily accept only a one way flow, nor are they designed for use in submarine or subaqueous environments.

The Sandstrom U.S. Pat. No. 5,167,802 describes a distributor valve which provides selective connection from a sample pump to a plurality of different collection units. The collection units include filters for removing particulate matter from water, for example collected from a river, and sample water collecting bottles. Water samples are collected automatically in response to a given condition or a passage of a preselected time period. The Sandstrom system provides both a sample operating mode for collecting samples, and a purge operating mode using a cleaning liquid. Alternation between the sampling mode and purging mode is accomplished by a four way valve.

The sample pump is connected between the water source and a distributor valve with one inlet port and forty-eight outlet ports of alternating sample outlet ports and purge outlet ports. Each sample outlet port leads to a collection unit and each purge port is for waste disposal. The distributor valve with forty-eight outlet ports is driven by a valve motor with a pawl and notch assembly which rotates an inlet disk to align the inlet port with one of the plurality of peripheral outlet ports. A timer computer controls the intermittent rotation of the disk.

The entire Sandstrom system however is arranged in the air and is not submerged. The Sandstrom system does not address the problems of submerged marine operation and cannot operate in the subaqueous or submarine environment. Furthermore it appears that a primary purpose of the purge operating mode is to clean the pump with methanol because the sample pump is interposed between the sampled source of water such as a river, and multiple sample receivers or collectors.

Another disadvantage of such multiport valve purging systems is that no provision is made for removing and diluting the cleaning liquid. Thus, the cleaning liquid itself may become a source of contamination in the case of a timed sequence of repeated sample collecting events using the same equipment.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a time series water sample collecting system for automatically collecting water samples at programmed intervals and at remote locations in submarine or submerged environments. The invention is intended for collecting samples in one way receivers such as sample collecting tubes, bottles, syringes or bags.

Another object of the invention is to provide a water sample collecting system without interposing a pump or other similar source of contamination between the sample water intake line and sample collectors. A downstream pump is instead used to draw sample water into sample collectors.

A further object of the invention is to provide a sample water collecting system with provision for washing away biofouling material in the sample water inlet line between sample collecting events. To this end, a cleaning liquid is flushed out the sample water intake line prior to collecting a sample. A related object of the invention is to provide active flushing away of the cleaning liquid in preparation for the next sample col-